AUTOMATIC RAILWAY PLATFORM SYSTEM

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ABSTRACT

The objective of this paper deals with automatic railway platform board opening at a level crossing without human intervention. In the present work it is proposed to substitute fully automated platform bridge facility in the station which helps peoples to move from flat form to flat form. Now a day all over the world accidents are common because of lack of technology, human carelessness at right time. And these accidental barriers cannot be completely avoidable but some fruitful steps definitely reduced to some extent, in account of this the initiative steps is required to avoid many humans death at any place and time by introducing new technologies, this effort has been taken in this work by adopting automated platform bridge. The above said system works on mechanical technique and rack and pinion mechanism which is employed to operate Platform Bridge.

Keywords- Railway Platform, Automated Platform Bridge, Rack and Pinion, Helical teeth, Roller Pinion.

INTRODUCTION

INTRODUCTION OF RAILWAY PLATFORM CROSSING:

The railway system is the one of the oldest and widely used mode of public transport. It is very efficient and popular, now a days due to increase in the population the railway has introduced multiplatform railway station to fulfill the demand of the generation. As multisided railway platform is used there needed the transport system to cross over the platform and reach another platform as per requirement. Scientist introduced the staircase bridging system that people and goods can be transferred from one platform to another. This system is very widely used and popular all over the world. In this there is a bridge made from entry gate of railway station and crossing over all the platforms and staircase are used accordingly to reach required platform as per the need of the traveler and coolies to transfer the goods and luggage.

INTRODUCTION OF AUTOMATIC RAILWAY PLATFORM CROSSING:

Staircase system of Railway crossing is older and not efficient as to transfer heavy luggage and mobility of people. This is very time consuming and laborious, sometimes to get shortcut to cross platform people suffers through dangerous accident and it costs their lives also. As day by day increase in demand and the technology we planned to develop the efficient way railway crossing. It is to use the platform when both the sided of train are not at station. It is

when the train leaves the station, two elevated plates from both the platform joins and makes the pedestrian pathway for people and luggage to crossover easily within no time from one platform to another, this system will be very efficient especially for the disabled people. And when train arrives on any side of two platform plates that formed path will be elevated again that gives way for train to stop on the station.

APPLICATIONS:

Some application of Automatic Railway Platform System are as listed:-

- Easy transfer of load and luggage
- Less time taking
- Safe
- Fruitful to handicapped people as it a straight path with wheel chair
- Less efforts required
- Can be used to clear the gap between the train and station

PROBLEMS AND SOLUTION OF RAILWAY PLATFORM CROSSING.

PROBLEM OF PRESENT RAILWAY PLATFORM CROSSING SYSTEM:

- Crossing the platform with staircase is too much time taking.
- It is very laborious to cross platform with luggage.
- Difficult to cross for handicapped people.

SOLUTION

- We designed platform crossing system which is easy safe and less time taking, and even more beneficial for transferring heavy load within no time.
- Lifted plate forming direct bridge between two platforms when train is not there which makes direct and shortest contact between two platforms comforting people to travel faster, easy and more efficient.

CONSTRUCTION AND WORKING OF RAILWAY PLATFORM CROSSING:

Construction

We designed railway platform crossing system which works fully on mechanical based system using rack and pinion arrangement. The part of rack is attached to the trains lower part and it rotates the pinion which than connected to another pinion which is rotated and it pulls off the plate or platform which is made for people to travel from one platform to another. Then again one more pinion is placed at the end of statin which contains two gears to give reverse motion to the rack and again puts down the plate or platform which gives way for people to travel from one platform to another. And this system is attached on both platforms.

Working

Working of railway platform crossing system is to pull off the plate or platform when train reaches station that is made on the track from both sides so that train can be on station without any hazard or accident. Then when train leaves station it is automatically put back on track for people to travel safely again. This makes the shortest distance between two platforms which are having track in between. This makes easy for heavy luggage, short time period for people to travel between platforms and especially very comfortable for handicapped people getting straight path travelling.

RACK AND PINION:

A **rack and pinion** is a type of linear actuator that comprises a pair of gears which convert rotational motion into linear motion. A circular gear called "the pinion" engages teeth on a linear "gear" bar called "the rack"; rotational motion applied to the pinion causes the rack to move relative to the pinion, thereby translating the rotational motion of the pinion into linear motion.

The flat, toothed part is the rack and the gear is the pinion. A piston coaxial to the rack provides hydraulic assistance force, and an open centered rotary valve controls the assist level. A rack and pinion gears system is composed of two gears. The normal round gear is the pinion gear and the straight or flat gear is the rack. The rack has teeth cut into it and they mesh with the teeth of the pinion gear.

A ring and pinion gear is the differential's critical point of power transfer. A ring and pinion gear set is one of the simplest performance modifications that can be performed on a vehicle. The most common reason to change ring and pinion ratios from the original equipment is to retain power when bigger tires are put on a vehicle. The torque can be increased by a ratio change when there is enhanced pulling or higher take off power from a dead start. A well designed mechanism such as the rack and pinion gears save effort and time.

TYPES OF RACK AND PINION:

- **Straight teeth** have the tooth axis parallel to the axis of rotation. Straight teeth that run parallel to the axis of the gear. Load movement or transfer is manual or walk-behind.

- **Helical teeth** gears provide continuous engagement along the tooth length and are often quieter and more efficient than straight tooth gears. Helical tooth gears resemble spur gears in the plane of rotation, but include teeth that are twisted along a helical path in the axial direction.

- **Roller pinion** drives use bearing supported rollers that mesh with the teeth of that rack in order to provide minimal to no backlash.

APPLICATION OF RACK AND PINION:

Rack and pinion gears provide a less mechanical advantage than other mechanisms, but greater feedback and steering sensation. A rack and pinion gear gives a positive motion especially compared to the friction drive of a wheel in tarmac. In a rack and pinion railway, a central rack between the two rails engages with a pinion on the engine allowing a train to be pulled up very steep slopes.

Rack and pinions gears are commonly used in the steering system of cars to convert the rotary motion of the steering wheel to the side to side motion in the wheels. The steering wheel rotates a gear which engages the rack. As the gear turns, it slides the rack either to the right or left, depending on which way the wheel is turned. Rack and pinion gears are also used in some scales to turn the dial that displays a weight.

RACK AND PINION GEAR TOOTH STRENGTH ESTIMATION:

Inputs in **BOLD,** outputs in **RED**		
Inputs		
Pitch, P	**24**	
Pressure angle, alpha (degrees, rad)	**14.5**	**0.253**
Safety factor, sf	**2**	
Number of teeth on pinion, N	**24**	
Tooth material	Nylon	
Allowable bending stress, sb (psi)	**6000**	
Tooth width, wr (in)	**0.250**	
Tooth geometry		
Circular pitch (in)	**0.1309**	
Tooth height (root to tip), hr (in)	**0.104**	
Addendum, ar (in)	**0.042**	

Dedendum, br (in)	**0.052**	
Clearance, cr (in)	**0.010**	
Tooth thickness, tr (in)	**0.065**	
Tooth thickness at root, trr (in)	**0.097**	
Shear area, Arear (in^2)	**0.016**	
I/C at root, Iocr (in^3)	**3.9E-04**	
Distance pitch line to root, hl (in)	**0.062**	
Rack		
Maximum tangential force to shear failure, Fsr (lbs)	**49.1**	
Maximum tangential force to bending failure, Fb (lbs)	**37.5**	
Maximum allowable tangential (rack) force, Fmax (lbs)	**18.7**	
Resulting force along line-of-action, FLA (lbs)	**19.4**	
Resulting separation force, Fspread (lbs)	**5.0**	
Pinion		
Pitch diameter, PD (inches)	**1.000**	
Torque to create axial force, Tmin (in-lbs, N-mm)	**9.7**	**1094**

Table: - 1 Rack and pinion gear tooth strength estimation.

- Production gears must be designed using Lewis Form Factor or FEA
- Pinion tooth geometry is assumed the same as for the rack!

Formulas for Determining the Tangential Force on rack and pinion tooth

$a = v/t_b$ [m/s²]

$F_u = (m.g + m.a)/1000$ (for lifting axle) [kN]

$F_u = (m.g.\ \mu + m.a)/1000$ (for driving axle) [kN]

$F_{u\ perm.} = F_{u\ Tab} / (K_A.S_B.f_n.L_{KHB})$ [kN]

RACK AND SPUR GEAR MESHING:

The table presents the method for calculating the mesh of a rack and spur gear. The table gives calculation of a meshed profile shifted spur gear and rack. If the profile shift coefficient x1 is 0, then it is the case of a standard gear meshed with the rack.

No.	Item	Symbol	Formula	Example	
				Spur gear	Rack
1	Module	m	Set Value	3	
2	Reference pressure angle	a		20 deg	
3	Number of teeth	z		12	–
4	Profile shift coefficient	x		0.6	
5	Height of pitch line	H		–	32.000
6	Working pressure angle	α_w		20 deg	
7	Mounting distance	a	$\frac{zm}{2} + H + xm$	51.800	
8	Reference diameter	d	zm	36.000	–
9	Base diameter	d_b	d cos α	33.829	
10	Working pitch diameter	d_w	$\frac{d_b}{\cos \alpha_w}$	36.000	
11	Addendum	h_a	m (1 + x)	4.800	3.000
12	Tooth depth	h	2.25m	6.750	
13	Tip diameter	d_a	$d + 2h_a$	45.600	–
14	Root diameter	d_f	$d_a - 2h$	32.100	

Table: - 2 Rack and spur gear meshing formula table

Figure of the meshing of standard spur gear and rack

(α = 20°, z1 = 12, x1 = 0)

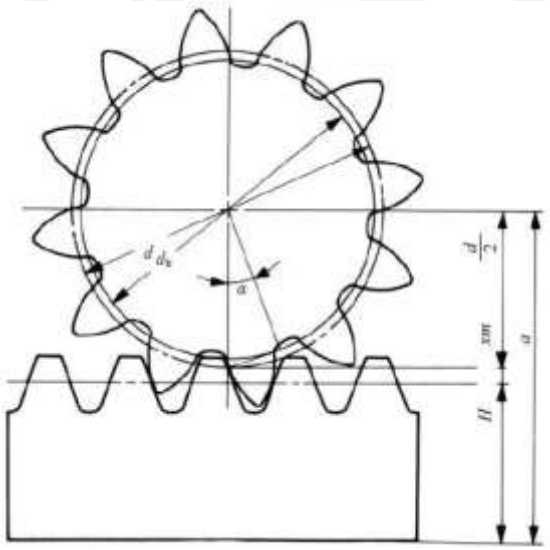
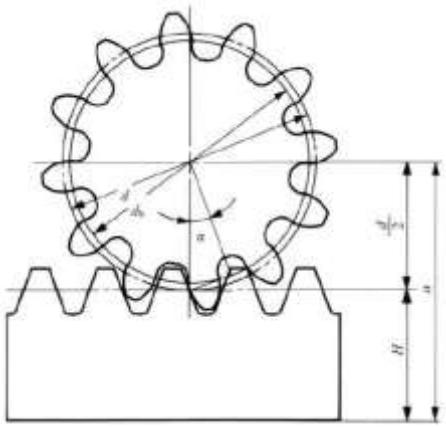


Figure of the meshing of profile shifted spur gear and rack

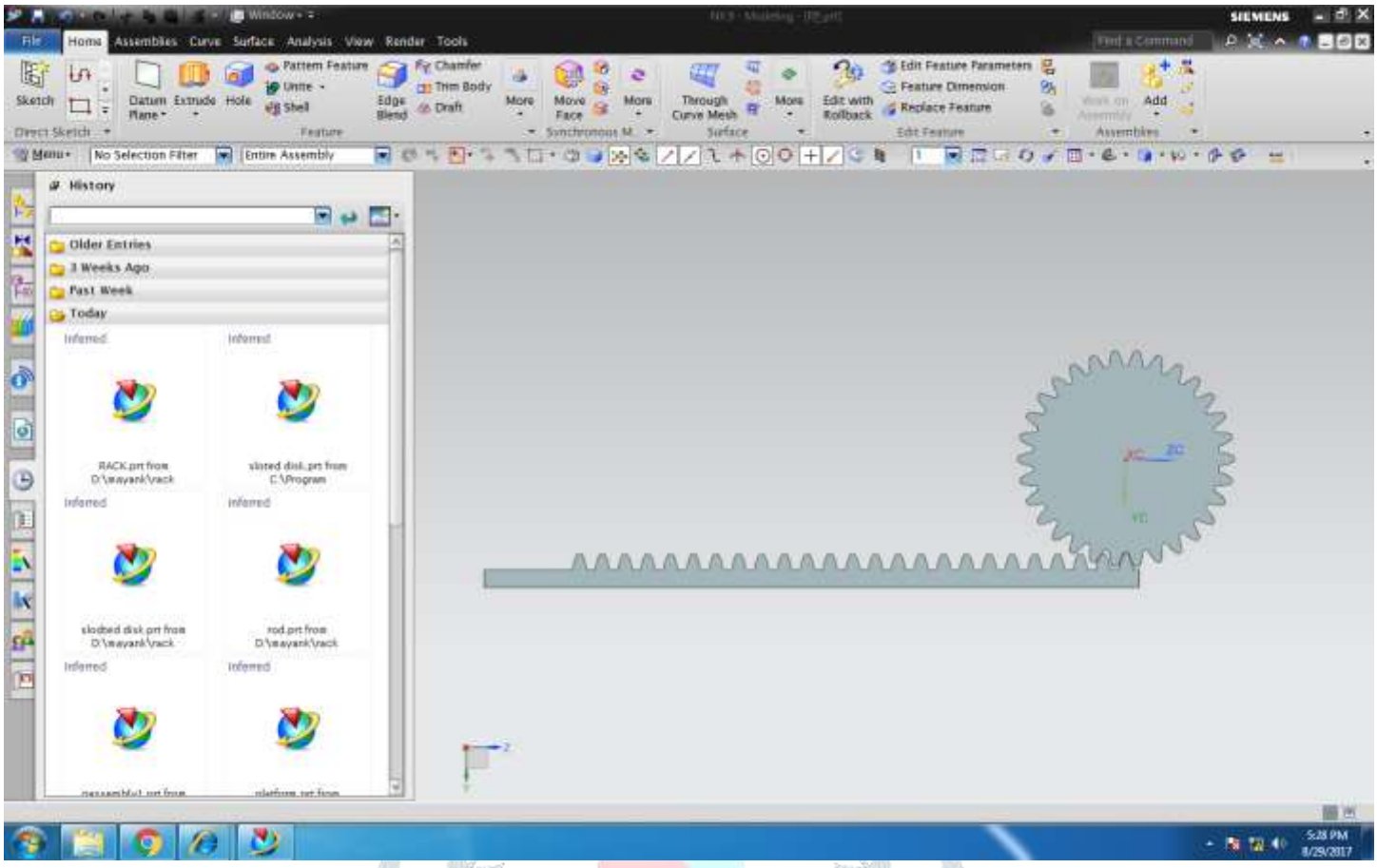
(α = 20°, z1 = 12, x1 = + 0.6)



Reversing the direction of rack by using Gear

To get reverse direction of rack by using another between rack and pinion gives required result motion. This is done to pull down the plate or platform to again make a bridge between two platforms when train crosses the station.

NX MODEL OF RACK AND PINION MESHING:


SIEMENS
File
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Render
Tools
Sketch
Datum Plane
Extrude
Hole
Pattern Feature
Unite
Shell
Edge Blend
Chamfer
Trim Body
Draft
More
Move Face
Through Curve Mesh
Edit with Rollback
Edit Feature Parameters
Feature Dimension
Replace Feature
Add
No Selection Filter
Entire Assembly
History
Older Entries
3 Weeks Ago
Past Week
Today
RACK.prt from D:\sayank\rack
slotted disk.prt from C:\Program
slotted disk.prt from D:\sayank\rack
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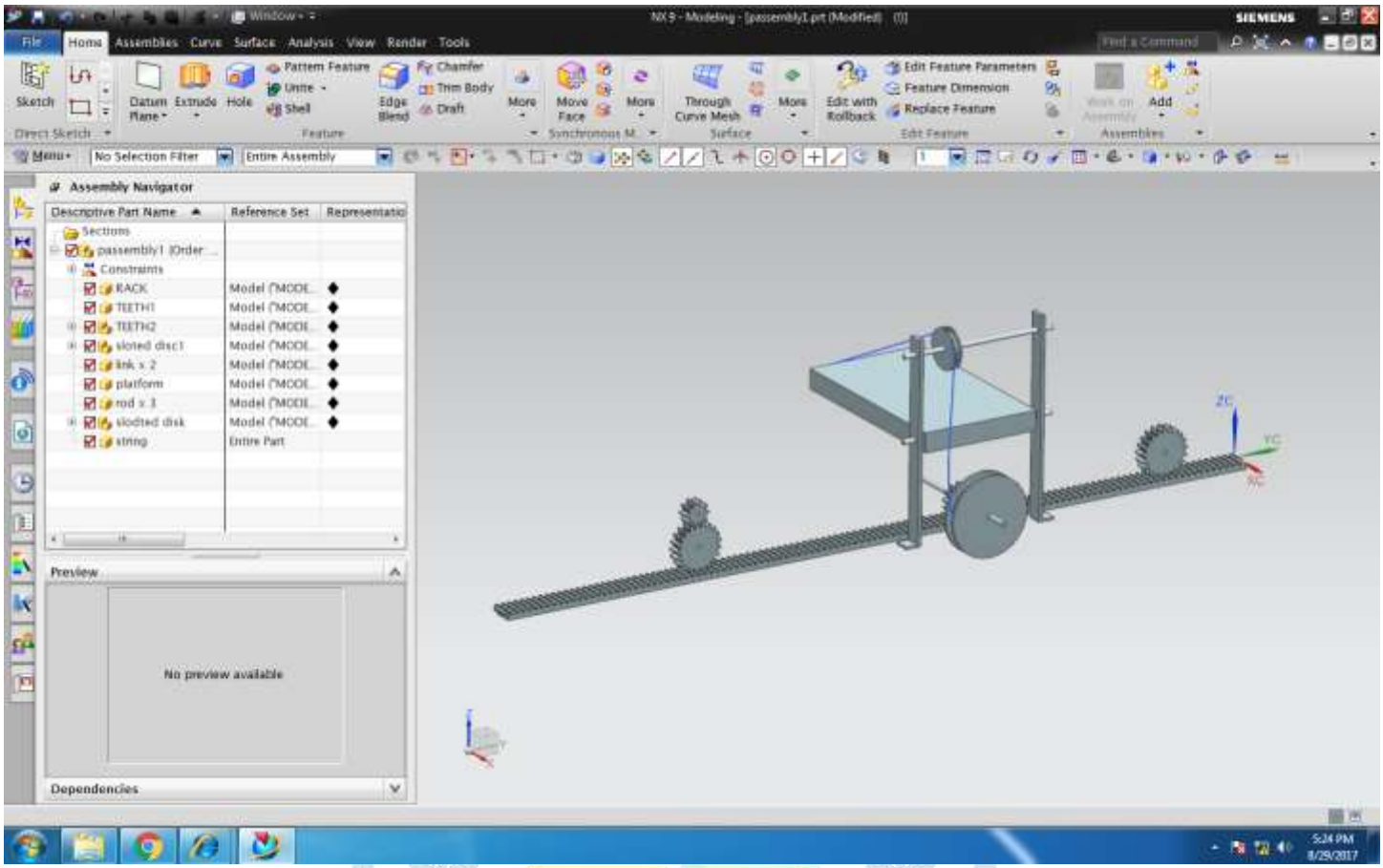
NX MODEL ASSEMBLY OF AUTOMATIC PLATFORM CROSSING SYSTEM:



CONCLUSION:

Design of automatic railway platform crossing system helps in many ways, it is easy to travel for people, it takes less time for people to travel, it reduces the laborious work of coolies and other goods transporter and it specially helps people travelling with wheel chair.

It reduces the bridged mountainous path and makes simple easy and flat path that people with wheel chair can travel easily without anyone's help. After all it increases the stability, comfort and safety of people with this new way of railway platform crossing system.

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